4.6. TANDEM SWITCHING

4.6.1. Real Time Limit, BHCA

Definition: The maximum number of BHCA a tandem switch can process.

Default Value:

Real Time Limit, BHCA
750,000

Support: Industry experience and expertise of Hatfield Associates. These numbers are well within the range of the BHCA limitations NORTEL supplies in its Web site. See 4.1.1.

4.6.2. Port Limit, Trunks

Definition: The maximum number of trunks that can be terminated on a tandem switch.

Default Value:

Port Limit, Trunks
100,000

Support: AT&T Updated Capacity Cost Study.[34]

4.6.3. Tandem Common Equipment Investment

Definition: The amount of investment in common equipment for a large tandem switch. Common Equipment is the hardware and software that is present in the tandem in addition to the trunk terminations themselves. The cost of a tandem is estimated by the HM as the cost of common equipment plus an investment per trunk terminated on the tandem.

Default Value:

Tandem Common Equipment Investment
$1,000,000

Support: AT&T Capacity Cost Study.[35]

4.6.4. Maximum Trunk Fill (Port Occupancy)

Definition: The fraction of the maximum number of trunk ports on a tandem switch that can be utilized.

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[34] Brand, T.L., Hallas, G.A., et al., "An Updated Study of AT&T's Competitors' Capacity to Absorb Rapid Demand Growth," April 19, 1995, p. 9.

[35] Blake, et. al., "A Study of AT&T's Competitors' Capacity to Absorb Rapid Demand Growth," p.9.

Default Value:

Maximum Trunk Fill (port occupancy)
0.90

Support: This is a Hatfield Associates estimate, which is used in lieu of forward looking alternatives from public sources or ILECs. It is based on consultations with AT&T and MCI subject matter experts.

4.6.5. Maximum Tandem Real Time Occupancy

Definition: The fraction of the total capacity (expresses as the real time limit, BHCA) a tandem switch is allowed to carry before an additional switch is provided.

Default Value:

Maximum Tandem Real Time Occupancy
0.9

Support: Bell Communications Research, *LATA Switching Systems Generic Requirements*, Section 17: Traffic Capacity and Environment, TR-TSY-000517, Issue 3, March 1989, figure 17.5-1, p. 17-24.

4.6.6. Tandem Common Equipment Intercept Factor

Definition: The multiplier of the common equipment investment input that gives the common equipment cost for the smallest tandem switch, allowing scaling of tandem switching investment according to trunk requirements.

Default Value:

Tandem Common Equipment Intercept Factor
0.50

Support: Value selected to allow tandem common equipment investment to range from $500,000 to $1,000,000 which is the appropriate range based on expertise of Hatfield Associates.

4.6.7. Entrance Facility Distance from Serving Wire Center & IXC POP

Definition: Average length of trunks connecting an IXC POP with the wire center that serves it.

Default Value:

Entrance Facility Distance from Serving Wire Center & IXC POP
0.5 miles

Support: Value selected in recognition of the fact that IXCs typically locate POPs close to the serving wire center to avoid long cable runs.

4.7. SIGNALING

4.7.1. STP Link Capacity

Definition: The maximum number of signaling links that can be terminated on a given STP pair.

Default Value:

STP Link Capacity
720

Support: AT&T Updated Capacity Cost Study.[36]

4.7.2. STP Maximum Fill

Definition: The fraction of maximum links (as stated by the STP link capacity input) that the model assumes can be utilized before it adds another STP pair.

Default Value:

STP Maximum Fill
0.80

Support: The STP maximum fill factor is based on Hatfield Associates engineering judgment and is consistent with maximum link/port fill levels throughout HM 4.0.

4.7.3. STP Maximum Common Equipment Investment, per Pair

Definition: The cost to purchase and install a pair of maximum-sized STPs.

Default Value:

STP Maximum Common Equipment Investment, per pair
$5,000,000

Support: AT&T Updated Capacity Cost Study.[37]

4.7.4. STP Minimum Common Equipment Investment, per Pair

Definition: The minimum investment for a minimum-capacity STP, i.e.: the fixed investment for an STP pair that serves a minimum number of links.

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[36] Brand, et al., "An Updated Study of AT&T's Competitors' Capacity to Absorb Rapid Demand Growth," p. 26.

[37] Brand, et al., "An Updated Study of AT&T's Competitors' Capacity to Absorb Rapid Demand Growth," p. 26.

Default Value:

STP Minimum Common Equipment Investment, per pair
$1,000,000

Support: It is necessary to allow the scaling of STP common equipment for smaller STPs that in some configuration are sufficient for local exchange carriers. The minimum STP common equipment investment cost is Hatfield Associates' judgment of the lower end of the range of common equipment investment.

4.7.5. Link Termination, Both Ends

Definition: The investment required for the transmission equipment that terminates both ends of an SS7 signaling link.

Default Value:

Link Termination, Both Ends
$900

Support: AT&T Updated Capacity Cost Study.[38]

4.7.6. Signaling Link Bit Rate

Definition: The rate at which bits are transmitted over an SS7 signaling link.

Default Value:

Signaling Link Bit Rate
56,000 bits per second

Support: The AT&T Updated Capacity Cost Study, and an SS7 network industry standard.[39]

4.7.7. Link Occupancy

Definition: The fraction of the maximum bit rate that can be sustained on an SS7 signaling link.

Default Value:

Link Occupancy
0.40

Support: AT&T Updated Capacity Cost Study .[40]

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[38] Brand, et al., "An Updated Study of AT&T's Competitors' Capacity to Absorb Rapid Demand Growth," p. 26.

[39] Brand, et al., "An Updated Study of AT&T's Competitors' Capacity to Absorb Rapid Demand Growth," p. 25.

[40] Brand, et al., "An Updated Study of AT&T's Competitors' Capacity to Absorb Rapid Demand Growth," p. 24.

4.7.8. C Link Cross-Section

Definition: The number of C-links in each segment connecting a mated STP pair.

Default Value:

C Link Cross-Section
24

Support: The input was derived assuming the 56 kbps signaling links between STPs are normally transported in a DS-1 signal, whose capacity is 24 DS-0s.

4.7.9. ISUP Messages per Interoffice BHCA

Definition: The number of Integrated Services Digital Network User Part (ISUP) messages associated with each interoffice telephone call attempt. Switches send to each other ISUP messages over the SS7 network to negotiate the establishment of a telephone connection.

Default Value:

ISUP messages per interoffice BHCA
6

Support: AT&T Updated Capacity Cost Study.[41]

4.7.10. ISUP Message Length, Bytes

Definition: The average number of bytes in each ISUP (ISDN User Part) message.

Default Value:

ISUP Message Length
25 bytes

Support: Bellcore Technical Reference TR-NWT-000317, Appendix A, shows that 25 bytes per message is a conservatively high figure. Northern Telecom's DMS-STP product/service information booklet shows an average ISUP message length of 25 bytes.[42] Therefore a default value of 25 average bytes per message is appropriate for use in the Hatfield Model.

4.7.11. TCAP Messages per Transaction

Definition: The number of Transaction Capabilities Application Part (TCAP) messages required per Service Control Point (SCP) database query. A TCAP message is a message between a switch and a

[41] Brand, at al., "An Updated Study of AT&T's Competitors' Capacity to Absorb Rapid Demand Growth," p. 25.

[42] Northern Telecom, DMS-STP Planner 1995, Product/Service Information, 57005.16, Issue 1, April, 1995, p.13.

database that is necessary to provide the switch with additional information prior to setting up a call or completing a call.

Default Value:

TCAP Messages per Transaction
2

Support: AT&T Updated Capacity Cost Study.[43]

4.7.12. TCAP Message Length, Bytes

Definition: The average length of a TCAP message.

Default Value:

TCAP Message Length
100 bytes

Support: Bellcore Technical Reference TR-NWT-000317, Appendix A, shows that 100 bytes per message is a conservatively high figure. Northern Telecom's DMS-STP product/service information booklet shows an average TCAP message length of 85 bytes.[44]

4.7.13. Fraction of BHCA Requiring TCAP

Definition: The percentage of BHCAs that require a database query, and thus generate TCAP messages.

Default Value:

Fraction of BHCA Requiring TCAP
0.10

Support: The AT&T Updated Capacity Cost Study assumes that 50% of all calls require a database query, but that is not an appropriate number to use in the HM because a substantial fraction of IXC calls are toll-free (800) calls.[45] When reduced to reflect the fact that a large majority of calls handled by the LECs are local calls that do not require such a database query, the 50% would be less than 10%; Hatfield Associates has used the 10% default as a conservatively high estimate.

4.7.14. SCP Investment per Transaction per Second

Definition: The investment in the SCP associated with database queries, or transactions, stated as the investment required per transaction per second. For example, if the default of $20,000 is assumed, an SCP

[43] Brand, et al., "An Updated Study of AT&T's Competitors' Capacity to Absorb Rapid Demand Growth," p. 25.

[44] DMS-STP Planner 1995, p.13.

[45] Brand, et al., "An Updated Study of AT&T's Competitors' Capacity to Absorb Rapid

required to handle 100 transactions per second would require a 2 million dollar ($20,000 times 100) investment.

Default Value:

SCP Investment per Transaction, per Second
$20,000

Support: AT&T Updated Capacity Cost Study uses a default value of $30,000 from the 1990 study, but notes that this is "conservatively high because of the industry's advances in this area and the resulting decrease in technology costs since the 1990 study."[46] The default value used in the HM represents the judgment of HAI as to the reduction of such processing costs since then.

[46] Brand, et al., "An Updated Study of AT&T's Competitors' Capacity to Absorb Rapid Demand Growth," p. 27.

4.8. OS AND PUBLIC TELEPHONE

4.8.1. Investment per Operator Position

Definition: The investment per computer required for each operator position.

Default Value:

Investment per Operator Position
$6,400

Support: Based on AT&T experience in the long distance business.

4.8.2. Maximum Utilization per Position, CCS

Definition: The estimated maximum number of CCS that one operator position can handle during the busy hour.

Default Value:

Maximum Utilization per Position
32 CCS

Support: Industry experience and expertise of Hatfield Associates in conjunction with subject matter experts.

4.8.3. Operator Intervention Factor

Definition: The percentage of all operator-assisted calls that require operator intervention, expressed as 1 out of every N calls, where N is the value of the input. Given the default values for operator-assisted calls, this parameter means that 1/10, or 10%, of the assisted calls actually require manual intervention of an operator, as opposed to *automated* operator assistance for credit card verification, etc.

Default Value:

Operator Intervention Factor
10

Support: Industry experience and expertise of Hatfield Associates.

4.8.4. Public Telephone Equipment Investment per Station

Definition: The weighted average cost of a public telephone and pedestal (coin/non-coin and indoor/outdoor).

Default Value:

Public Telephone Equipment Investment, per Station
$760

Support: New England Incremental Cost Study.[47]

[47] New England Telephone Company, "1993 New Hampshire Incremental Cost Study," p. 90.

4.9. ICO PARAMETERS

4.9.1. ICO STP Investment, per Line

Definition: The surrogate value for equivalent per line investment in STPs by a small independent telephone company (ICO), that is used in lieu of calculating it directly in the model.

Default Value:

ICO STP Investment per Line
$5.50

Support: The average STP investment per line estimated by the Hatfield Model for all states, with 20 percent added to reflect the higher cost a small ICO is likely to encounter, due to its character of use.

4.9.2. ICO Local Tandem Investment, per Line

Definition: The surrogate value for the per line investment in a local tandem switch by a small independent telephone company (ICO), that is used in lieu of calculating it directly in the model.

Default Value:

Per Line ICO Local Tandem Investment
$1.90

Support: The average local tandem investment per line from the Hatfield Model, with 20 percent added to reflect the higher cost a small ICO is likely to encounter, due to its character of use.

4.9.3. ICO OS Tandem Investment, per Line

Definition: The surrogate value for the per line investment in an Operator Services tandem switch by a small independent telephone company (ICO),that is used in lieu of calculating it directly in the model.

Default Value:

Per Line ICO OS Tandem Investment
$0.80

Support: The average OS tandem investment per line from the Hatfield Model, with 20 percent added to reflect the higher cost a small ICO is likely to encounter, due to its character of use.

4.9.4. ICO SCP Investment, per Line

Definition: The surrogate value for the per line investment in a SCP by a small independent telephone company (ICO), that is used in lieu of calculating it directly in the model.

Default Value:

Per Line ICO SCP Investment
$2.50

Support: The average SCP investment per line from the Hatfield Model, with 20 percent added to reflect the higher cost a small ICO is likely to encounter, due to its character of use.

4.9.5. ICO Local Tandem Wire Center Investment, per Line

Definition: The surrogate value for the per line investment in a local tandem wire center by a small independent telephone company (ICO), that is used in lieu of calculating it directly in the model.

Default Value:

Per Line ICO Local Tandem Wire Center Investment
$2.50

Support: The average local tandem wire center investment per line from the Hatfield Model, with 20 percent added to reflect the higher cost a small ICO is likely to encounter, due to its character of use.

4.9.6. ICO OS Tandem Wire Center Investment, per Line

Definition: The surrogate value for the per line investment in a operator services tandem wire center by a small independent telephone company (ICO), that is used in lieu of calculating it directly in the model.

Default Value:

Per Line ICO OS Tandem Wire Center Investment
$1.00

Support: The average OS tandem wire center investment per line from the Hatfield Model, with 20 percent added to reflect the higher cost a small ICO is likely to encounter, due to its character of use.

4.9.7. ICO STP/SCP Wire Center Investment, per Line

Definition: The surrogate value for the per line investment in an STP/SCP wire center by a small independent telephone company (ICO), that is used in lieu of calculating it directly in the model.

Default Value:

Per Line STP / SCP Wire Center Investment
$0.40

Support: The average STP/SCP wire center investment per line from the Hatfield Model, with 20 percent added to reflect the higher cost a small ICO is likely to encounter, due to its character of use.

4.9.8. ICO C-Link / Tandem A-Link Investment, per Line

Definition: The surrogate value for the per line investment in a C-link / tandem A-link by a small independent telephone company (ICO), that is used in lieu of calculating it directly in the model.

Default Value:

Per Line ICO C-Link / Tandem A-Link Investment
$0.30

Support: The average C-Link / tandem A-link investment per line from the Hatfield Model, with 20 percent added to reflect the higher cost a small ICO is likely to encounter, due to its character of use.

5. EXPENSE

5.1. COST OF CAPITAL AND CAPITAL STRUCTURE

Definition: The capital cost structure, including the debt/equity ratio, cost of debt, and return on equity, that make up the overall cost of capital.

Default Values:

Cost of Capital	
Debt percent	0.450
Cost of debt	0.077
Cost of equity	0.119
Weighted average cost of capital	0.1001

Support: Based on FCC-approved cost of capital methodology using 1996 financial data and AT&T and MCI-sponsored DCF and CAPM analyses calculating the RBOCs' cost of capital. See, for example, "Statement of Matthew I. Kahal Concerning Cost of Capital," In the Matter of Rate of Return Prescription for Local Exchange Carriers," File No. AAD95-172, March 11, 1996. See also AT&T ex parte filing of February 12, 1997, "Estimating the Cost of Capital of Local Telephone Companies for the Provision of Network Elements," by Bradford Cornell, September, 1996.

5.2. DEPRECIATION AND NET SALVAGE

Definition: The economic life of various network plant categories.

Default Values:

Plant Type	Economic Life	Net Salvage %
motor vehicles	8.24	11.21
garage work equipment	12.22	-10.71
other work equipment	13.04	3.21
buildings	46.93	1.87
furniture	15.92	6.88
office support equipment	10.78	6.91
company comm. Equipment	7.40	3.76
general purpose computers	6.12	3.73
digital electronic switching	16.17	2.97
operator systems	9.41	-0.82
digital circuit equipment	10.24	-1.69
public telephone term. Equipment	7.60	7.97
poles	30.25	-89.98
aerial cable, metallic	20.61	-23.03
aerial cable, non metallic	26.14	-17.53
underground cable, metallic	25.00	-18.26
underground cable, non metallic	26.45	-14.58
buried cable, metallic	21.57	-8.39
buried cable, non metallic	25.91	-8.58
intrabuilding cable, metallic	18.18	-15.74
intrabuilding cable, non metallic	26.11	-10.52
conduit systems	56.19	-10.34

Support: The default values are the weighted average set of projected depreciation lives, and net salvage percentages, coming from 76 LEC study areas including all the BOCs, SNET, Cincinnati Bell, and numerous GTE and United companies. Weighting is based on total lines per operating company. The projected lives and salvage values are determined in a triennial review process involving each state PUC, the FCC, and the LEC to establish unique state-and-operating-company-specific depreciation schedules. See, FCC Public Notice D.A. #'s 95-1635, 93-970, 96-1175, 94-856, 95-1712. NID and SAI lives are calculated as the average life of metallic cable, since lives are not separately specified for those plant categories and they are classified as outside plant.

5.3. STRUCTURE SHARING FRACTION

Definition: The fraction of investment in distribution and feeder poles and trenching that is assigned to LECs. The remainder is attributed to other utilities/carriers.

Default Values:

Structure Percent Assigned to Telephone Company						
	Distribution			Feeder		
Density Zone	Aerial	Buried	Underground	Aerial	Buried	Underground
0-5	.50	.33	1.00	.50	.40	.50
5-100	.33	.33	.50	.33	.40	.50
100-200	.25	.33	.50	.25	.40	.40
200-650	.25	.33	.50	.25	.40	.33
650-850	.25	.33	.40	.25	.40	.33
850-2,550	.25	.33	.33	.25	.40	.33
2,550-5,000	.25	.33	.33	.25	.40	.33
5,000-10,000	.25	.33	.33	.25	.40	.33
10,000+	.25	.33	.33	.25	.40	.33

Support: Industry experience and expertise of Hatfield Associates and outside plant engineers; Montgomery County, MD Subdivision Regulations Policy Relating to Grants of Location for New Conduit Network for the Provision of Commercial Telecommunications Services; Monthly Financial Statements of the Southern California Joint Pole Committee; Conversations with representatives of local utility companies. See the structure sharing discussion in Appendix B.

5.4. OTHER EXPENSE INPUTS

5.4.1. Income Tax Rate

Definition: The composite federal and state income tax rate on earnings paid by a telephone company.

Default Value:

Income Tax Rate
39.25%

Support: Based on a nationwide average of composite federal and state tax rates.

5.4.2. Corporate Overhead Factor

Definition: Forward-looking corporate overhead costs, expressed as a fraction of the sum of all capital costs and operations expenses calculated by the model.

Default Value:

Overhead Factor
10.4%

Support: Based on data from AT&T's Form M. See, also earlier ex parte submission by AT&T dated March 18, 1997 and Appendix C.

5.4.3. Other Taxes Factor

Definition: Operating taxes (primarily gross receipts and property taxes) paid by a telephone company in addition to federal and state income taxes.

Default Value:

Other Taxes Factor
5%

Support: This is the average for all Tier I LECs, expressed as a percentage of total revenue. Revenue and tax data are taken from ARMIS report 43-03. See, also Appendix B.

5.4.4. Billing/Bill Inquiry per Line per Month

Definition:

The cost of bill generation and billing inquiries for end users, expressed as an amount per line per month.

Default Value:

Billing / Bill Inquiry per line per month
$1.22

Support: Based on data found in the New England Incremental Cost Study, section for billing and bill inquiry where unit costs are developed. This study uses marginal costing techniques, rather than TSLRIC. Therefore, billing/bill inquiry-specific fixed costs were added to conform with TSLRIC principles.[48]

To compute this value from the NET study, the base monthly cost for residential access lines is divided by the base demand (lines) for both bill inquiry (p. 122) and bill production (p. 126). The resulting per-line values are added together to arrive at the total billing/bill inquiry cost per line per month.

5.4.5. Directory Listing per Line per Month

Definition: The monthly cost of creating and maintaining white pages listings on a per line, per month basis.

Default Value:

Directory Listing per line per month
$0.15

Support: This is a Hatfield Associates estimate.

5.4.6. Forward-Looking Network Operations Factor

Definition: The forward-looking factor applied to a specific category of expenses reported in ARMIS called Network Operations. The factor is expressed as the percentage of current ARMIS-reported Network Operations costs per line.

Default Value:

Forward Looking Network Operations Factor
50%

Support: ARMIS-based network operations expenses are -- by definition -- a function of telephone company embedded costs. As reported, these costs are artificially high because they reflect antiquated systems and practices that are more costly than the modern equipment and practices that the Hatfield Model assumes will be installed on a forward-looking basis. Furthermore, today's costs do not reflect much of the substantial savings opportunities posed by new technologies, such as new management network standards, intranets, and the like. See Appendix D for a more detailed discussion of the savings opportunities associated with network operations.

5.4.7. Alternative Central Office Switching Expense Factor

Definition: The expense to investment ratio for digital switching equipment, used as an alternative to the ARMIS expense ratio, reflecting forward looking rather than embedded costs. Thus, this factor multiplies the calculated investment in digital switching in order to determine the monthly expense associated with digital switching. This factor is not intended to capture the cost of software upgrades to the switch, as all switching software is part of the capital value inputs to HM 4.0.

[48] Ibid., p. 122, 126.

Default Value:

Alternative Central Office Switching Expense Factor
2.69%

Support: New England Incremental Cost Study.[49]

5.4.8. Alternative Circuit Equipment Factor

Definition: The expense to investment ratio for all circuit equipment (as categorized by LECs in their ARMIS reports), used as an alternative to the ARMIS expense ratio to reflect forward looking rather than embedded costs.

Default Value:

Alternative Circuit Equipment Factor
0.0153

Support: New England Incremental Cost Study.[50]

5.4.9. End Office Non Line-Port Cost Fraction

Definition: The fraction of the cost of switching that is associated with switch usage, as opposed to the port (non-traffic sensitive) costs.

Default Value:

End Office Non Line-Port Cost Fraction
70%

Support: This factor is a Hatfield Associates estimate of the average over several different switching technologies.

5.4.10. Monthly LNP Cost, per Line

Definition: The estimated cost of permanent Local Number Portability (LNP), expressed on a per-line, per-month basis, including the costs of implementing and maintaining the service. This is included in the USF calculations only, not the UNE rates, because it will be included in the definition of universal service once the service is implemented.

Default Value:

Per Line Monthly LNP Cost
$0.25

[49] Ibid., p. 394

[50] Ibid., p. 394

Support: This estimate is based on an ex parte submission by AT&T to the FCC in CC Docket No. 95-116.

5.4.11. Carrier-Carrier Customer Service, per Line, per Year

Definition: The yearly amount of customer operations expense associated with the provision of unbundled network elements by the LECs to carriers who purchase those elements.

Default Value:

Carrier-Carrier Customer Service per line
$1.69

Support: This calculation is based on data drawn from LEC ARMIS accounts 7150, 7170, 7190 and 7270 reported by all Tier I LECs in 1995. To calculate this charge, the amounts shown for each Tier 1 LEC in the referenced accounts are summed across the accounts and across all LECs, divided by the number of access lines reported by those LECs in order to express the result on a per-line basis, and multiplied by 70% to reflect forward-looking efficiencies in the provision of network elements. See, also Appendix C.

5.4.12. NID Expense, per Line, per Year

Definition: The estimated annual NID expense on a per line basis, based on an analysis of ARMIS data modified to reflect forward looking costs. This is for the NID only, not the drop wire, which is included in the ARMIS cable and wire account.

Default Value:

NID Expense per line per year
$1.00

Support: The opinion of outside plant experts indicate a failure rate of less than 0.25 per 100 lines per month, or 3 percent per year. At a replacement cost of $29, this would yield an annual cost of $0.87. Therefore, the current default value is conservatively high.

5.4.13. DS-0/DS-1 Terminal Factor

Definition: The relative terminal investment per DS-0, between the DS-1 and DS-0 levels.

Default Value:

DS-0 / DS-1 Terminal Factor
12.4

Support: The computed ratio for investment per DS-0 when provided in a DS-0 level signal, to per DS-0 investment when provided in a DS-1 level signal, based on transmission terminal investments (see 4.4.1 for terminal investments).

5.4.14. DS-1/DS-3 Terminal Factor

Definition: The relative investment per DS-0, between the DS-3 and DS-1 levels.

Default Value:

DS-1 / DS-3 Terminal Factor
9.9

Support: The computed ratio for investment per DS-0 when provided in a DS-1 level signal, to per DS-0 investment when provided in a DS-3 level signal, based on transmission terminal investments (i.e., 4.4.1).

5.4.15. Average Lines per Business Location

Definition: The average number of business lines per business location, used to calculate NID and drop cost. This parameter should be set the same as 2.2.5.

Default Value:

Average Business Lines per Location
4

Support: ***{NOTE: The discussion in Section 2.2.5. [Distribution] is reproduced here for ease of use.}***

The number of lines per business location estimated by Hatfield Associates is based on data in the *1995 Common Carrier Statistics* and the *1995 Statistical Abstract of the United States*.

5.4.16. Average Trunk Utilization

Definition: The 24 hour average utilization of an interoffice trunk.

Default Value:

Average Trunk Utilization
0.30

Support: AT&T Capacity Cost Study.[51]

[51] Blake, et al., "A Study of AT&T's Competitors' Capacity to Absorb Rapid Demand Growth," p.4.

6. EXCAVATION AND RESTORATION

6.1. UNDERGROUND EXCAVATION

Definition: The cost per foot to dig a trench in connection with building an underground conduit system to facilitate the placement of underground cables. Cutting the surface, placing the 4" PVC conduit pipes, backfilling the trench with appropriately screened fill, and restoring surface conditions is covered in the following section titled, "Underground Restoration Cost per Foot". These two sections do not include the material cost of the PVC conduit pipe, which is covered under "Conduit Material Investment per foot", and is affected by the number of cables placed in a conduit run, and the number of "Spare tubes per Route."

Default Values:

Underground Excavation Costs per Foot					
Density Range	Trenching Per Foot	Backhoe		Hand Trench	
		Fraction	Per Foot	Fraction	Per Foot
0-5	$1.90	45.00%	$3.00	1.00%	$5.00
5-100	$1.90	45.00%	$3.00	1.00%	$5.00
100-200	$1.90	45.00%	$3.00	1.00%	$5.00
200-650	$1.90	45.00%	$3.00	3.00%	$5.00
650-850	$1.95	45.00%	$3.00	3.00%	$5.00
850-2,550	$2.15	45.00%	$3.00	5.00%	$5.00
2,550-5,000	$2.15	55.00%	$3.00	10.00%	$5.00
5,000-10,000	$6.00	67.00%	$20.00	10.00%	$10.00
10,000+	$6.00	72.00%	$30.00	12.00%	$18.00

Note: Fraction % for Trenching is the fraction remaining after subtracting Backhoe % & Trench %.

Support: See discussion in Section 6.2.

6.2. UNDERGROUND RESTORATION

Definition: The cost per foot to cut the surface, place the 4" PVC conduit pipes, backfill the trench with appropriately screened fill, and restore surface conditions. Digging a trench in connection with building an underground conduit system to facilitate the placement of underground cables is covered in the preceding section titled, "Underground Excavation Cost per Foot". These two sections do not include the material cost of the PVC conduit pipe, which is covered under "Conduit Material Investment per foot", and is affected by the number of cables placed in a conduit run, and the number of "Spare tubes per Route."

Default Values:

Underground Restoration Costs per Foot									
	Cut/Restore Asphalt		Cut/Restore Concrete		Cut/Restore Sod		Simple Backfill	Conduit Placement & Stabilization	
Density Range	Fraction	Per Foot	Fraction	Per Foot	Fraction	Per Foot	Per Foot	Pavement Per Foot	Dirt Per Foot
0-5	55.00%	$6.00	10.00%	$9.00	1.00%	$1.00	$0.15	$5.00	$1.00
5-100	55.00%	$6.00	10.00%	$9.00	1.00%	$1.00	$0.15	$5.00	$1.00
100-200	55.00%	$6.00	10.00%	$9.00	1.00%	$1.00	$0.15	$5.00	$1.00
200-650	65.00%	$6.00	10.00%	$9.00	3.00%	$1.00	$0.15	$5.00	$1.00
650-850	70.00%	$6.00	10.00%	$9.00	4.00%	$1.00	$0.15	$5.00	$1.00
850-2,550	75.00%	$6.00	10.00%	$9.00	6.00%	$1.00	$0.15	$9.00	$4.00
2,550-5,000	75.00%	$6.00	15.00%	$9.00	4.00%	$1.00	$0.15	$13.00	$11.00
5,000-10,000	80.00%	$18.00	15.00%	$21.00	2.00%	$1.00	$0.15	$17.00	$12.00
10,000+	82.00%	$30.00	16.00%	$36.00	0.00%	$1.00	$0.15	$20.00	$16.00

Note: Fraction % for Simple Backfill is the fraction remaining after subtracting Asphalt % & Concrete % & Sod %.

Support: The costs reflect a mixture of different types of placement activities.

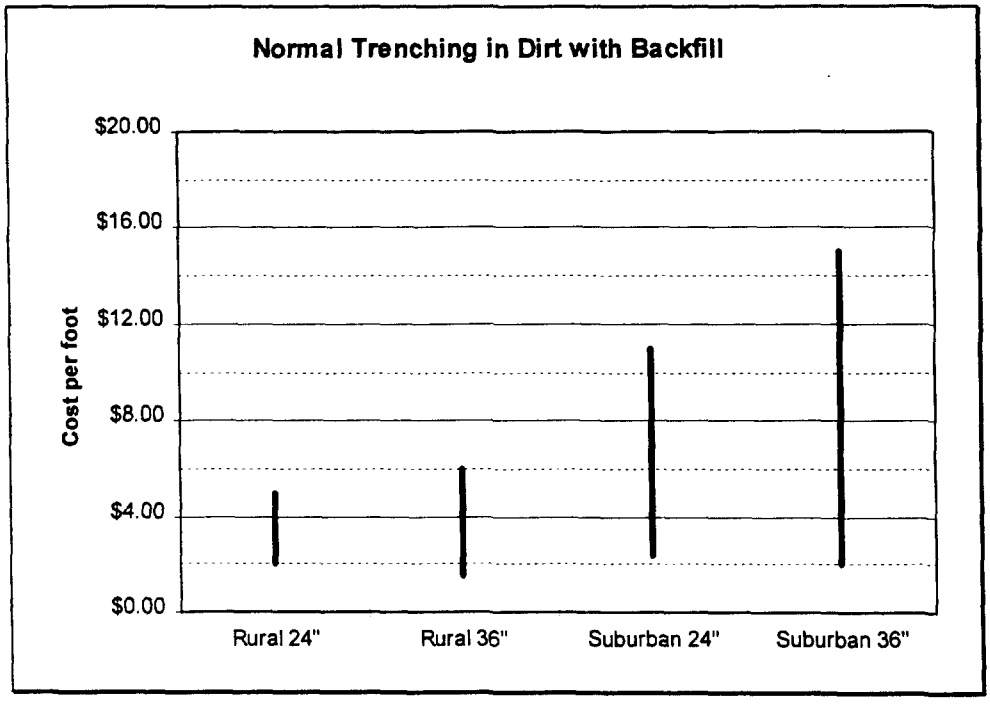
Note: Use of underground conduit structure for distribution should be infrequent, especially in the lower density zones. Although use of conduit for distribution cable in lower density zones is not expected, default prices are shown, should a user elect to change parameters for percent underground, aerial, and buried structure allowed by the HM 4.0 model structure.

A compound weighted cost for conduit excavation, placement and restoral can be calculated by multiplying the individual columns shown above and in the immediately preceding section, "Underground Excavation Costs per Foot". Performing such calculations using the default values shown would provide the following composite costs by density zone.

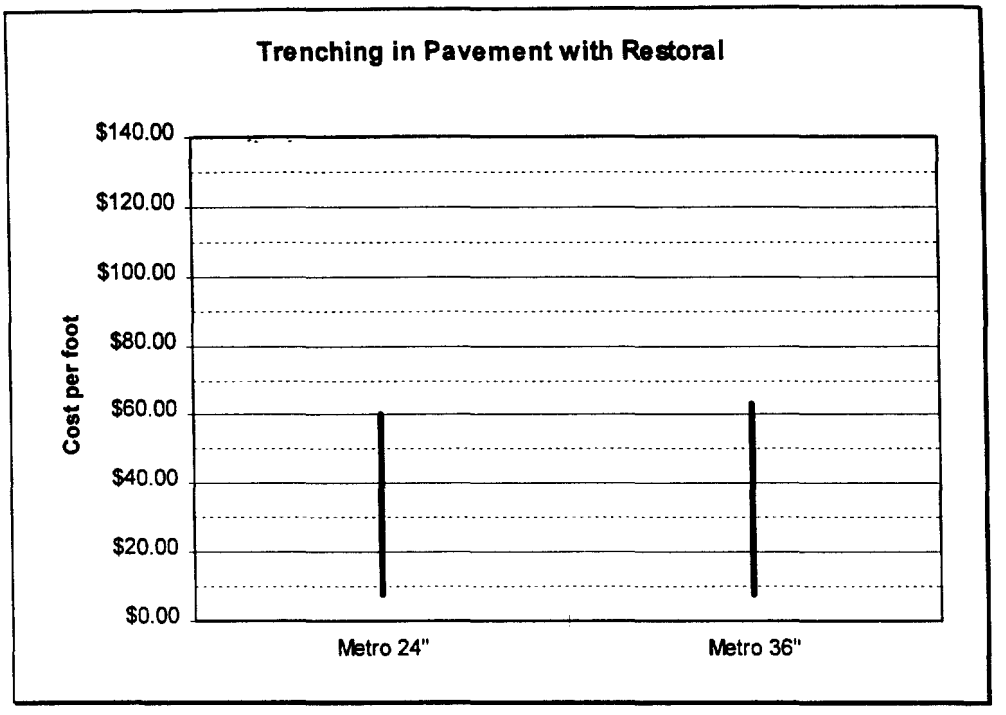
Underground Excavation, Restoration, and Conduit Placement Cost per Foot	
Density Zone	Cost Per Foot
0-5	$10.29
5-100	$10.29
100-200	$10.29
200-650	$11.35
650-850	$11.88
850-2,550	$16.40
2,550-5,000	$21.60
5,000-10,000	$50.10
10,000+	$75.00

Costs for various trenching methods were estimated by a team of experienced outside plant experts. Additional information was obtained from printed resources[52]. Still other information was provided by several contractors who routinely perform excavation, conduit, and manhole placement work for telephone companies. Results of those inquiries are revealed in the following charts. Note that this survey demonstrates that costs do not vary significantly between buried placements at 24" underground versus 36" underground. Therefore the Hatfield Model assumes an average placement depth ranging from 24" to 36", averaging 30".

Conduit placement cost is essentially the same, whether the conduit is used to house distribution cable, feeder cable, interoffice cable, or other telecommunication carrier cable, including CATV.



[52] Martin D. Kiley and Marques Allyn, eds., *1997 National Construction Estimator 45th Edition*, pp. 12-15.


Trenching in Pavement with Restoral
$140.00
$120.00
$100.00
$80.00
$60.00
$40.00
$20.00
$0.00
Cost per foot
Metro 24"
Metro 36"

6.3. BURIED EXCAVATION

Definition: The cost per foot to dig a trench to allow buried placement of cables, or the plowing of one or more cables into the earth using a single or multiple sheath plow.

Default Values:

Buried Excavation Costs per Foot									
	Plow		Trench	Backhoe		Hand Trench		Bore Cable	
Density Range	Fraction	Per Foot	Per Foot	Fraction	Per Foot	Fraction	Per Foot	Fraction	Per Foot
0-5	60.00%	$0.80	$1.90	10.00%	$3.00	0.00%	$5.00	0.00%	$11.00
5-100	60.00%	$0.80	$1.90	10.00%	$3.00	0.00%	$5.00	0.00%	$11.00
100-200	60.00%	$0.80	$1.90	10.00%	$3.00	0.00%	$5.00	0.00%	$11.00
200-650	50.00%	$0.80	$1.90	10.00%	$3.00	1.00%	$5.00	0.00%	$11.00
650-850	35.00%	$0.80	$1.95	10.00%	$3.00	2.00%	$5.00	0.00%	$11.00
850-2,550	20.00%	$1.20	$2.15	10.00%	$3.00	4.00%	$5.00	3.00%	$11.00
2,550-5,000	0.00%	$1.20	$2.15	10.00%	$3.00	5.00%	$5.00	4.00%	$11.00
5,000-10,000	0.00%	$1.20	$6.00	10.00%	$20.00	6.00%	$10.00	5.00%	$11.00
10,000+	0.00%	$1.20	$15.00	25.00%	$30.00	10.00%	$18.00	5.00%	$18.00

Note: Fraction % for Regular Trenching is the fraction remaining after subtracting Plow %, Backhoe %, Hand Trench %, and Bore Cable %.

Support: See discussion in Section 6.4.

6.4. BURIED INSTALLATION AND RESTORATION

Definition: The cost per foot to push pipe under pavement , or the costs per foot to cut the surface, place cable in a trench, backfill the trench with appropriately screened fill, and restore surface conditions. Digging a trench in connection with placing buried cable is covered in the preceding section titled, "Buried Excavation Cost per Foot".